Antibiotics and Facial Fractures: Evidence-Based Recommendations Compared with Experience-Based Practice

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Abstract

Efficacy of prophylactic antibiotics in craniofacial fracture management is controversial. The purpose of this study was to compare evidence-based literature recommendations regarding antibiotic prophylaxis in facial fracture management with expert-based practice. A systematic review of the literature was performed to identify published studies evaluating pre-, peri-, and postoperative efficacy of antibiotics in facial fracture management by facial third. Study level of evidence was assessed according to the American Society of Plastic Surgery criteria, and graded practice recommendations were made based on these assessments. Expert opinions were garnered during the Advanced Orbital Surgery Symposium in the form of surveys evaluating senior surgeon clinical antibiotic prescribing practices by time point and facial third. A total of 44 studies addressing antibiotic prophylaxis and facial fracture management were identified. Overall, studies were of poor quality, precluding formal quantitative analysis. Studies supported the use of perioperative antibiotics in all facial thirds, and preoperative antibiotics in comminuted mandible fractures. Postoperative antibiotics were not supported in any facial third. Survey respondents ($n = 17$) cumulatively reported their antibiotic prescribing practices over 286 practice years and 24,012 facial fracture cases. Percentages of prescribers administering pre-, intra-, and postoperative antibiotics, respectively, by facial third were as follows: upper face 47.1, 94.1, 70.6; midface 47.1, 100, 70.6%; and mandible 68.8, 94.1, 64.7%. Preoperative but not postoperative antibiotic use is recommended for comminuted mandible fractures. Frequent use of pre- and postoperative antibiotics in upper and midface fractures is not supported by literature recommendations, but with low-level evidence. Higher level studies may better guide clinical antibiotic prescribing practices.

Keywords
- facial fracture
- antibiotic prophylaxis
- craniofacial trauma
- mandible fracture
- frontal sinus fracture
- surgical site infection

Approximately 3 million individuals suffer craniofacial trauma in the United States on a yearly basis,[1] and approximately 50% of all wounds presenting to emergency rooms involve the head and neck.[2] In 2007, facial fractures accounted for more than 400,000 emergency department admissions.[3] Surgical intervention is often necessary in the management of

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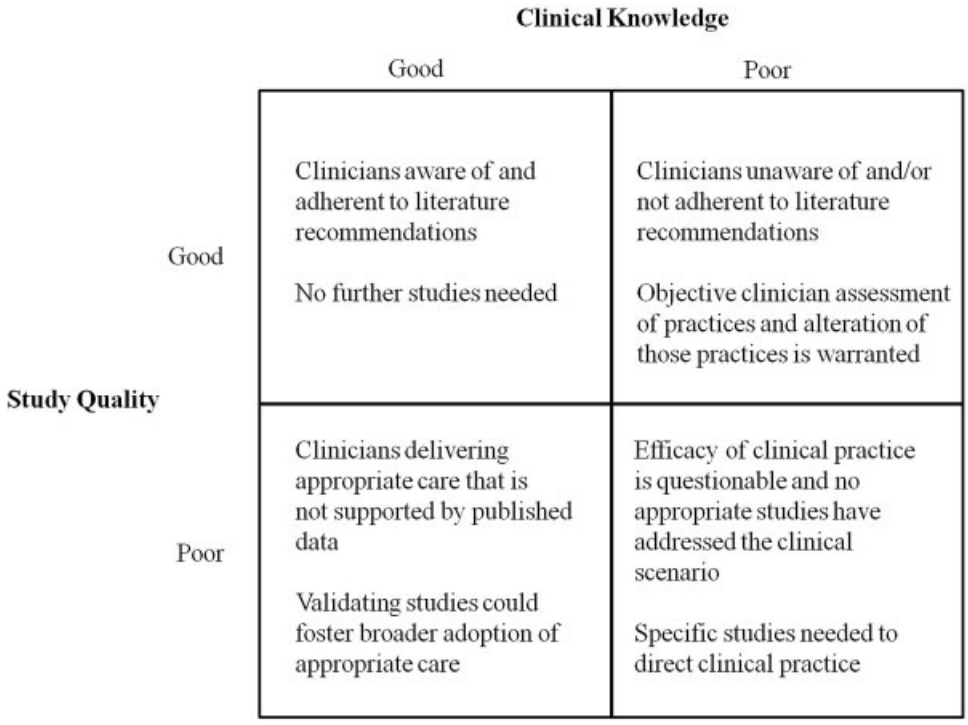

Fig. 1 Comparison of clinical knowledge base and literature quality for a given clinical scenario. Clinical practices that are at odds with literature recommendations are understandable in situations where the literature is poor, but should be changed if they are at odds with well-designed studies that address the clinical scenario. Alternatively, research studies should be designed to guide clinical practice in those situations where clinical efficacy is unclear or practitioners are uncertain.

craniomaxillofacial fractures, and poses a significant public health burden in terms of comorbidity and financial cost.[4–6]

The prevention of surgical site infections is a major focus of The Joint Commission Centers for Medicare and Medicaid Services Surgical Care Improvement Project (SCIP),[7] and the efficacy of prophylactic antibiotics has been proven in multiple clinical trials.[8] In the modern era of managed health care, it has become common practice for hospitals to closely monitor and even restrict antibiotic use in surgical patients. Risks of antibiotic treatment, uncertainty regarding the efficacy of antibiotics in specific scenarios, the possibility of antibiotic resistance, prescriber inattention to antibiotic course, and cost containment are all commonsense justification for greater scrutiny of surgical antibiotic prescribing practices.[9–11]

Despite increased regulation in health care, physicians maintain great autonomy and individuality in clinical practice. Antibiotics can be administered preoperatively (i.e., from the time of injury or presentation to the time of surgery), perioperatively (i.e., immediately before surgery and continuing through the procedure, but not more than 24 hours postprocedure, often called "prophylactic" antibiotics), or postoperatively (i.e., continuing past the perioperative period). Surgical antibiotic prescribing practices remain largely dependent on surgeon choice, which, although based on personal experience and surgical training, should be supported by objective evidence. However, when looking to the medical literature for guidance with regard to antibiotic prescribing practices for specific scenarios, there is little available data and controversy abounds for even the most basic questions regarding surgical antibiotic administration (►**Fig. 1**). For example, even the efficacy of perioperative antibiotic timing, a major component of SCIP guidelines, has recently been called into question.[7,8,12] Studies generally focus on perioperative antibiotic administration, but do not address the utility of preoperative or postoperative antibiotic use, nor the choice of antibiotic in specific situations.

With regard to antibiotic prescribing practices in craniofacial fracture surgery, there are no current standard recommendations. In extrapolating data from recommendations for orthopedic procedures involving fractures, there is suggested benefit to perioperative antibiotics in open fracture repair, and, in extrapolating from head and neck oncologic procedures, for clean-contaminated procedures that involve an incision through the oral or pharyngeal mucosa.[13] If perioperative antibiotics are used, the first dose should be administered less than 60 minutes before surgical incision, or between 60 and 120 minutes of incision if vancomycin or clindamycin is used. Antibiotic duration should be less than 24 hours without continuation beyond this point. For head and neck procedures not involving mucosal incisions, perioperative antibiotics are not recommended, yet this recommendation conflicts with orthopedic fracture recommendations where antibiotics may be indicated despite skin-only incisions. Preoperative

and postoperative antibiotics are not endorsed, but, again, are not specific to craniofacial fracture management.

Unique situations in the management of craniofacial fractures, such as contamination of fracture sites from the sinuses, exposure of fractures to intraoral bacteria from mucosal tears, and delay in fracture management, intuitively suggest that there may be benefit to preoperative and prolonged postoperative antibiotic administration in craniofacial fractures. The antibiotic prescribing practices of craniofacial surgeons are largely unknown, and may conflict with broader surgical antibiotic prescribing recommendations.

The purpose of this study was to compare evidence-based literature recommendations regarding antibiotic administration in operative craniofacial fracture repair with expert-based practice. Further resolution with regard to preoperative, perioperative, and postoperative antibiotic time points, as well as fracture location in the craniofacial skeleton would be useful to guide both clinical practice and identify areas where research efforts would be beneficial.

Methods

A systematic literature review was performed in June 2013 using Medline, Embase, PubMed and Cochrane databases to identify published studies evaluating the use of antibiotics in craniofacial trauma including the upper, middle, and lower thirds of the craniofacial skeleton. Search terms included "frontal sinus," "nasal bone," "zygoma," "orbit," "mandible," "fracture," "antibiotics," "prophylaxis," and "facial fracture" alone and in combination. Included studies were limited to the English language, and related articles were used to broaden the search. Identified abstracts and included studies were independently evaluated by three reviewers for inclusion or exclusion based on study design, study population, and indications for antibiotics. Studies were excluded if two out of three reviewers concluded that they did not meet inclusion criteria.

Data from selected studies were tabulated, and grouped according to both fracture area addressed (upper, middle, and/or mandible) and time point of antibiotic administration. Preoperative antibiotics were defined as antibiotics administered from the time of presentation, but before surgical intervention. Perioperative antibiotics were defined as antibiotics administered at the time of surgery, but not continuing for longer than 24 hours postoperatively. Postoperative antibiotics were defined as antibiotics administered beyond the 24 hours postoperative time point. Additional extracted data included first author, year of publication, study population characteristics, study design, number of patients, indications for antibiotics, and choice of antibiotics. Included studies were graded from Levels I–V according to the American Society of Plastic Surgery (ASPS) Evidence Rating Scales.[14] Level V studies were included.[15] Evidence rating was used to make grading recommendations for antibiotic prescribing practices according to ASPS Scale for Grading Recommendation guidelines.[16]

Expert opinions were garnered during the *Advanced Orbital Surgery Symposium*, held on May 3–5, 2012, in Baltimore, Maryland, in the form of surveys evaluating senior surgeon clinical antibiotic prescribing practices by facial third. Data queried included first, second, and third choices of antibiotic, time points of administration (pre-, peri-, and/or postoperative), and duration of postoperative antibiotic use, if applicable. Statistical

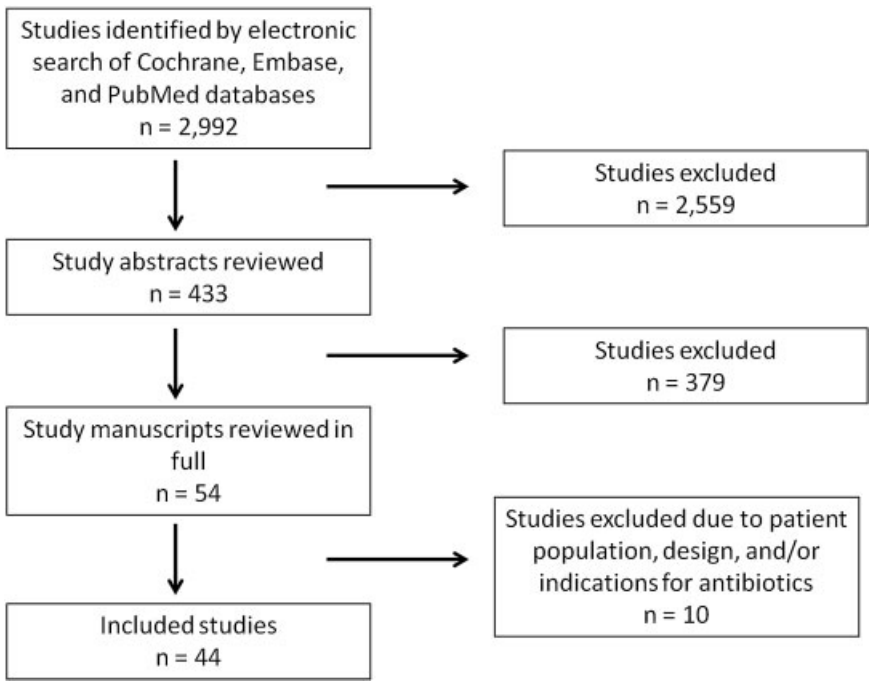

Fig. 2 Systematic literature review strategy to identify studies addressing antibiotic prophylaxis in surgical facial fracture management.

evaluation of prescriber practices was performed using two-sided Student *t*-tests. Results were considered significant at a p-value < 0.05.

Results

Systematic literature review identified 44 studies from eight countries addressing antibiotics and facial fracture management (►**Fig. 2**).[1,17–59] Extracted study data are presented in ►**Table 1**. Overall, studies were of poor quality, precluding formal quantitative analysis; 29.5% ($n = 13$ were Level I or II. Most studies addressed fractures of the mandible ($n = 27$, 61.3%), followed by midface ($n = 20$, 45.5%), and then upper face ($n = 7$, 15.9%). Four studies (9%) addressed midface and mandible fractures, while three studies (6.8%) addressed all three fracture regions. Level of evidence increased with inferior fracture location, with 14.3% ($n = 1$), 20.0% ($n = 4$), and 37.0% ($n = 10$) of studies reporting Levels I and II evidence for upper, middle, and mandible fractures, respectively. Penicillins, cephalosporins, and clindamycin were the most commonly prescribed antibiotics, but no determination could be made regarding superiority of any antibiotic at any time point.

Studies supported the use of perioperative antibiotics in all facial thirds, especially if mucosal incisions were used (Grade A recommendation).[31,32,47] In contrast, preoperative antibiotics were not recommended for upper and midface fractures (Grade C recommendation),[1,22,42,56] while preoperative antibiotic use was supported for comminuted mandible fractures (Grade A recommendation).[21–23,29,50] Postoperative antibiotics were not recommended for upper and midface fractures (Grade C recommendations)[20,27,41] and were associated with increased morbidity in upper face fractures in one Level IV study.[41] The administration of postoperative antibiotics was also not supported in mandible fractures, even if comminuted (Grade A recommendation).[22–24,26,31,34,37] There was inconsistent low-level evidence suggesting benefit from prescribing prophylactic antibiotics in patients with premorbid acute or chronic sinusitis with midface fractures (Grade D recommendation).[17,40,43,45,51,53,56,57]

Survey respondents ($n = 17$) cumulatively reported their antibiotic prescribing practices over 286 practice years, 24,012 facial fracture cases, three countries (United States [$n = 15$], Canada [$n = 1$], and Germany [$n = 1$]), and 13 institutions. Cefazolin and clindamycin were most commonly prescribed in all situations, while vancomycin, metronidazole, and piperacillin/tazobactam were least commonly prescribed (►**Table 2**). In contrast to literature recommendations, percentages of prescribers administering pre-, intra-, and postoperative antibiotics, respectively, by facial third were as follows: upper face 47.1, 94.1, 70.6%; midface 47.1, 100, 70.6%; and mandible 68.8, 94.1, 64.7% (►**Table 3**). For those prescribing postoperative antibiotics, average duration for upper face, midface, and mandible fractures was 3.7, 4.0, and 4.6 days, respectively (range 1–7 days in each facial third). There were no significant differences between prescribing practices by facial third (all time point comparison p-values > 0.22).

Discussion

Overall, prescriber practice differed markedly with literature recommendations with the exception of perioperative antibiotic administration. These differences and their implications for both clinical practice and study design can be conceptualized by evaluating whether study quality and clinical knowledge are either good or poor for a given clinical scenario (►**Fig. 1**). The importance of perioperative antibiotic administration, especially in clean-contaminated procedures,[8,13,60] such as procedures involving oral incisions, is well supported in the literature (Grade A recommendation),[31,32,47] and survey respondents indicated their practices reflect this in all facial thirds. For mandible fractures, preoperative antibiotics are supported for compound mandible fractures (Grade A recommendation).[21–23,29,50] This may be the only other scenario where surgeon practice was congruous with literature recommendations as reflected in higher reported rates of preoperative antibiotic use in mandible fractures as compared with mid- and upper face fractures, though these differences were not significant. Unfortunately, our survey did not query more specific attributes (i.e., open/closed, displaced/nondisplaced, etc.) of fractures in each region, and whether clinicians alter their prescribing practices in response to these fracture features cannot be addressed by our study design.

The incongruity of literature recommendations and prescriber practice identified in most antibiotic prescribing scenarios is due to both poor prescriber adherence to good literature, and clinicians practicing in complex clinical scenarios where little appropriate literature exists (►**Fig. 1**). Overall, studies addressing antibiotic use were of poor quality, especially for upper and midface fractures, and their results were often not presented in clinically useful ways.[21] In these situations, practitioners likely revert to the default of prescribing antibiotics, as indicated by high overall rates of preantibiotic and postantibiotic administration in upper and midface fractures despite literature recommendations to the contrary (Grade C recommendations).[1,20,22,27,41,42,56] We attempted to make these data more clinically approachable by clarifying and organizing data presentation for all reviewed studies.

In contrast, in scenarios where high-quality studies have essentially answered clinical questions, prescriber incongruity is likely due to disagreement with specifics of study design/study population, or ignorance of existing literature. This may be the case for mandible fractures, where the literature is overall of higher quality. The identified literature does not support continued postoperative antibiotics (Grade A recommendation),[22–24,26,31,34,37] yet 64.7% of practitioners say they administer postoperative antibiotics for an average of 4.6 days postoperatively. Similarly, practitioners may not prescribe preoperative antibiotics in compound mandible fractures despite strong literature evidence to the contrary (Grade A recommendation).[21–23,29,50]

Our results highlight several areas where further research is clearly warranted. The issue of premorbid acute or chronic sinusitis and risk for orbital cellulitis in patients with untreated midface fracture was addressed in multiple Level V studies.[17,40,43,45,51,53,56,57] Most authors felt that

Table 1 Summary of included studies grouped by ASPS level of evidence and facial third

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
1	Zix et al	Prospective randomized controlled trial	I	Midface	62	Orbital floor fractures requiring repair; excluded gunshot wounds, patients admitted to intensive care unit, allergic to β-lactam antibiotics, and skull base fractures	Postoperative	Amoxicillin/clavulanic acid 625 mg po tid 1 vs. 4 d postoperatively
2	Kyzas et al	Systematic literature review	I	Mandible	5,437/31	Studies enrolling five or more patients and using prophylactic antibiotics in mandibular fractures	Perioperative, postoperative	Various
3	Andreasen et al	Systematic literature review	I	Midface, Mandible	461/6	RCTs or CCSs evaluating prophylactic antibiotics in facial fractures	Perioperative, postoperative	Various
4	Miles et al	Prospective randomized controlled trial	I	Mandible	181	Patients treated for open mandibular fractures over a 4-y period; excluded gunshot wounds and patients presenting with infection; minimum 5-wk follow-up; all patients treated with preoperative antibiotics due	Postoperative	2.4 mIU intramuscular penicillin G benzathine or 5–7 postoperative d course of clindamycin if penicillin allergic compared with no postoperative antibiotics; all patients received preoperative and intraoperative antibiotics
5	Abubaker et al	Prospective randomized placebo-controlled trial	I	Mandible	30	Isolated, noncomminuted mandible fractures; excluded gunshot wounds; all patients operatively treated within 5 days of injury	Postoperative	Penicillin VK 500 mg every 6 hours for 5 d postoperatively vs. placebo

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
6	Heit et al	Prospective randomized controlled trial	I	Mandible	90	Patients presenting with compound mandible fractures	Preoperative, perioperative	Ceftriaxone 1 g IV daily vs. penicillin 2 million units IV every 4 h; either regimen initiated from admission until postoperative day 1; all patients then received penicillin VK 500 mg po every 6 h for 1 wk postoperatively
7	Gerlach et al	Prospective randomized controlled trial	I	Mandible	200	Patients undergoing intraoral mandibular fracture miniplate fixation; excluded patients with previous antibiotic administration within 14 d preinjury	Perioperative	Mezlocillin/oxacillin 6 g IV, dosed every 8 h; one dose vs. 1 d postoperative vs. 3 postoperative days vs. no perioperative antibiotics
8	Bellamy et al	Retrospective case series	II	Upper face	242	Patients with surgically treated frontal sinus fractures over a 15-y period	Postoperative	Not reported
9	Knepil et al	Prospective cohort	II	Midface	134	Patients undergoing treatment of zygoma or zygomaticomaxillary complex fractures at three different institutions; patients with coronal flaps were excluded	Perioperative	Cefuroxime 750 mg vs. amoxicillin clavulanic acid 1.2 g vs. cofluampicil 250/250, all administered perioperatively; metronidazole 500 mg was added in the cefuroxime group if performing intraoral reduction and plating; no antibiotics were administered in closed-reduction cases

(*Continued*)

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
10	Ghazal et al	Prospective case series	II	Mandible	28	Patients presenting with nondisplaced mandibular fractures treated nonoperatively; excluded high condylar neck fractures; patients followed for an average of 15 wk	Preoperative	Amoxicillin/clavulanic acid 2 g po daily for 5 d postinjury
11	Ellis et al	Prospective case series	II	Mandible	81	Dentate patients with noncomminuted angle fractures treated with a single 2.0 mm miniplate with at least 6 wk of follow-up	Perioperative	Not reported
12	Chole et al	Prospective controlled trial	II	Midface, mandible	101	Patients with facial fractures able to consent for study enrollment	Perioperative	Cefazolin 2 g IV intraoperatively and 8 h postoperatively vs. no antibiotics
13	Zallen et al	Prospective controlled trial	II	Mandible	62	Patients presenting with compound mandibular fractures requiring either open or closed fracture reduction; excluded gunshot wounds, excluded condylar fractures	Preoperative, perioperative, postoperative	Various, nonprotocol driven
14	Adalarasan et al	Retrospective case–control	III	Midface, mandible	67	Patients presenting with maxillofacial fractures requiring surgical treatment; excluded patients with antibiotic use within 30 d of injury	Perioperative	Penicillin 2 million units IV vs. cefotaxime 2 g IV vs. no antibiotic
15	Lovato et al	Retrospective case series	III	Mandible	150	patients with mandibular fractures	Perioperative, postoperative	Various

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
						treated operatively with minimum 6 wk postoperative follow-up		
16	Malanchuk et al	Retrospective case series	III	Mandible	789	Patients with mandible fractures through tooth-bearing segments over a 4-y period	Preoperative, perioperative, postoperative	Various
17	James	Prospecitve case series	III	Mandible	4	Patients with operatively treated mandibular factures	Postoperative	Not reported
18	Hindawi et al	Retrospective case series	IV	Mandible	197	Patients presenting with open and closed mandibular fractures	Perioperative, postoperative	Various
19	Lauder et al	Retrospective case series	IV	Upper face, midface, mandible	223	Patients presenting with facial injuries as identified by ICD-9 coding	Preoperative, perioperative, postoperative	Not reported
20	Bui et al	Retrospective case series	IV	Mandible	49	Patients undergoing angle fracture treatment with 2.0 mm 8-hole strut plates with at least 4-mo follow-up	Preoperative, perioperative, postoperative	Not reported
21	Senel et al	Retrospective case series	IV	Mandible	120	Patients treated for mandibular fractures over a 3-y period	Preoperative, perioperative, postoperative	Penicillin or clindamycin
22	Furr et al	Retrospective case series	IV	Mandible	271	Patients presenting with mandible fractures over a 5-y period	Preoperative, perioperative, postoperative	Clindamycin 600 plus cephazolin 1 g given perioperatively, or clindamycin 300 mg three times daily or cephalexin 500 mg

(*Continued*)

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
								four times daily if used preoperatively or postoperatively; some patients did not receive antibiotics
23	Ben Simon et al	Retrospective case series	IV	Midface	4	Patients presenting with orbital fractures over a 10-y period at one institution, combined with patients presenting with orbital floor fractures over a 12-y period at an additional institution; patients developing orbital cellulitis within 6 wk of orbital floor fracture were identified	Preoperative, perioperative, postoperative	Various
24	Lee et al	Retrospective case series	IV	Upper face	79	Patients with bitable frontal sinus fractures, with or without other facial fractures	Postoperative	Penicillin 2 million units IV every 4 h, or chloramphenicol 1 g every 6 h for at least 1 wk postoperatively, followed by an additional 1 wk of oral antibiotic (first or second generation cephalosporin); if gross wound contamination, IV antibiotics were continued for 2 postoperative wk before conversion to oral antibiotics
25	Choi et al	Retrospective case series	IV	Upper face	293	Patients with head injuries and anterior	Preoperative, perioperative, postoperative	Various

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
						table basilar skull fractures		
26	Silver et al	Retrospective case series	IV	Midface	3	Patients with postseptal orbital infections found to have associated orbital fractures with or without concomitant zygomaticomaxillary complex fractures that were not operatively managed	Preoperative	Not reported
27	Hall et al	Retrospective case series	IV	Mandible	116	Patients presenting with mandibular fractures over a 3-y period	Perioperative	Not reported
28	Golbfarb et al	Retrospective case series	IV	Midface	3	Patients with orbital fractures treated nonoperatively that developed orbital cellulitis	Preoperative	Ampicillin 500 po BID in one case; cephalexin in another; no antibiotics in one case
29	Adkins et al	Retrospective case series	IV	Upper face	13	Patients presenting with isolated frontal sinus fractures over a 10-y period	Preoperative, perioperative, postoperative	Not reported
30	Larsen et al	Retrospective case series	IV	Mandible	229	Patients presenting with mandibular fractures over a 9-y period	Perioperative	Not reported
31	Kerr	Retrospective case series	IV	Midface, Mandible	16	Patients with infections after maxillofacial fracture repair over a 7-y period	Preoperative, perioperative, postoperative	Not reported
32	Abubaker	Expert opinion	V	Mandible	Not applicable	Not reported	Preoperative	Not reported

(*Continued*)

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
33	Ellis et al	Expert opinion	V	Mandible	Not applicable	Not reported	Preoperative, perioperative, postoperative	Penicillin or clindamycin for patients with penicillin allergies
34	Srinivasan	Retrospective case series	V	Midface	2	Patients with zygomatic fractures with maxillary antral involvement treated nonoperatively that subsequently developing orbital cellulitis	Preoperative	Not reported
35	Stacey et al	Expert opinion	V	Mandible	Not applicable	Not reported	Preoperative, perioperative, postoperative	Penicillin with metronidazole or clindamycin
36	Martin et al	Literature review	V	Midface	214	Papers addressing prophylactic antibiotic use in patients with nondisplaced orbital floor or maxillary fractures	Preoperative	Not reported
37	Courtney et al	Practitioner survey	V	Midface	Not applicable	Practitioner survey regarding clinical treatment of isolated orbital floor fractures	Preoperative, perioperative, postoperative	Various
38	Newlands	Expert opinion	V	Midface	2	Patients with facial fractures involving the orbit developing cellulitis	Preoperative	Not reported
39	Shuttleworthet al	Case report	V	Midface	1	Patient with untreated midface fractures developing orbital cellulitis after nose-blowing, visual acuity limited to hand motion after resolution of infection	Preoperative	Not reported

Table 1 (*Continued*)

Study no.	Author	Study design	Level of evidence	Fractures evaluated	Number of analyzed patients/ number of studies reviewed	Inclusion/exclusion criteria	Antibiotic administration time points evaluated	Antibiotics used or evaluated
40	McLoughlin et al	Practitioner survey	V	Midface	Not applicable	Practitioner survey regarding clinical treatment of zygomatic-complex fractures	Preoperative, perioperative, postoperative	Various
41	Paterson	Case report	V	Midface	1	Patient with conservatively managed naso-orbital fracture with concomitant chronic sinusitis developing orbital cellulitis	Preoperative	Not reported
42	Westfall et al	Case report	V	Midface	1	Patient with untreated orbital floor fracture developing orbital cellulitis	Preoperative	Not reported
43	Janecka	Expert opinion	V	Upper face, midface, mandible	Not applicable	Not reported	Preoperative, perioperative, postoperative	Not reported
44	Greenberg et al	Expert opinion	V	Upper face, midface, mandible	Not applicable	Not reported	Preoperative, perioperative, postoperative	Not reported

Abbreviations: CCSs, case-control studies; RCTs, randomized controlled trials.

Table 2 Expert percentage first choice antibiotic use by time point and facial fracture region

Antibiotic	Preoperative antibiotic use			Perioperative antibiotic use			Postoperative antibiotic use		
	Upper face fracture (%)	Middle face fracture (%)	Mandible fracture (%)	Upper face fracture (%)	Middle face fracture (%)	Mandible fracture (%)	Upper face fracture (%)	Middle face fracture (%)	Mandible fracture (%)
Cephazolin	75	75	63.6	68.8	70.6	68.8	63.6	72.7	70
Ciprofloxacin	12.5	–	–	12.5	–	–	–	0	–
Clindamycin	–	12.5	18.2	–	11.8	12.5	9.1	9.1	10
Penicillin	–	–	–	6.3	5.9	6.3	9.1	–	–
Ampicillin/sulbactam	12.5	12.5	18.2	12.5	11.8	12.5	18.2	18.2	20

Note: Metronidazole, vancomycin, and piperacillin/tazobactam were not chosen as a first choice antibiotic by any survey respondent.

patients with pre-existing sinusitis and midface fractures should be treated with preoperative antibiotics in the hope of reducing the risk of orbital cellulitis, but this is unproven, and the number needed to treat to prevent orbital cellulitis is unknown. This question could be answered in prospective fashion. Moreover, studies addressing antibiotic use and midface fractures are few in number and of poor quality. Practice recommendations would benefit from better quality studies addressing midface fractures. The same can be said for upper face fractures, where studies were least frequent and of overall lowest quality, with no study reporting Level I evidence.

The question arises, what makes for a "good" study addressing antibiotics and facial fractures? In addition to a prospective, randomized design that will specifically answer a clinical question and a study population with enough power to generate significance, it is our opinion that "good" studies in this field need to possess additional qualities specific to craniofacial trauma. Given the complexity of the craniofacial skeleton and the complexity of managing craniofacial fractures in patients with other traumatic injuries, studies need to have greater specificity with regard to fracture type, number of areas fractured, displacement, comminution, and exposure.[61,62] No study has explored antibiotic efficacy between simple (i.e., one fractured region) or complex (i.e., multiregion or panfacial) craniofacial fractures, and differences could be found between these populations. In addition, craniofacial fractures are frequently treated in polytrauma patients, who can receive antibiotics for several reasons unrelated to their craniofacial injuries.[27] Studies must carefully address this issue, and should control for several confounding variables, such as time from injury to operative intervention,[27,33] the presence of associated cerebrospinal fluid leak,[41] and the presence of basilar skull fractures.[63] Overall injury severity should be considered in regression modeling with control of predictor outcome variables by widely accepted global injury scoring systems, such as the injury severity score, or Glasgow coma scale.[63,64] Finally, the timing, choice, and dose of evaluated antibiotics, which were poorly reported in upper and midface studies, should be clearly stated and their administration rigorously controlled. This is best achieved through prospective study design.

Although literature reviews and practitioner surveys have inherent drawbacks, we sought to minimize issues associated with these study designs. The literature was systematically and thoroughly evaluated, and results from studies were tabulated using our anatomical and time point schemes to facilitate comparisons and maximize extraction of study data to clinical practice. Similarly, survey respondents were asked to provide data relevant to clinical practice for the same locations and time points, and were all experts in craniofacial trauma. The study was not designed as a meta-analysis of specific antibiotic superiority for any time point/fracture location combination, and, indeed, we found that data of this resolution would be too sparse to perform meta-analyses in most situations, with the possible exception of preoperative and postoperative antibiotic administration in mandible fractures.[21]

Table 3 Expert frequency of antibiotic use by facial fracture region and time point

Time period	Frequency and duration of antibiotic use		
	Upper face fracture	Middle face fracture	Mandible fracture
Preoperative	47.1%	47.1%	68.8%
Perioperative	94.1%	100%	94.1%
Postoperative	70.6%	70.6%	64.7%
Average duration (d)	3.7	4.0	4.6
Range (d)	1–7	1–7	1–7

Conclusion

Frequent use of pre- and postoperative antibiotics in upper and midface fractures is not supported by literature recommendations, but with low-level evidence. Prophylactic antibiotic use was evaluated by higher level of evidence studies for mandible fractures: preoperative antibiotic use in comminuted mandible fractures is supported, but postoperative antibiosis in mandible fractures is not. Well designed and higher level of evidence studies, especially for upper and midface fractures, may better guide clinical antibiotic prescribing practices.

Note

This study was presented, in part, as a poster at the 92nd Annual Meeting of The American Association of Plastic Surgeons, April 21, 2013, New Orleans, LA. Abstract #P34. No author has any financial disclosures relevant to this article, or conflict of interest to declare.

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